AN ASSESSMENT OF THE "SPAN SPRAY" LOW VOLUME SPRAY APPLICATION EQUIPMENT

Ontario
Ministry of the Environment

The Honourable
George A. Kerr, Q.C.,
Minister

Everett Biggs,
Deputy Minister

AN ASSESSMENT OF THE "SPAN SPRAY" LOW VOLUME SPRAY APPLICATION EQUIPMENT

PREPARED FOR THE

ONTARIO MINISTRY OF THE ENVIRONMENT

BY

THE ONTARIO PESTICIDES ADVISORY COMMITTEE

MARCH 1976

The Honourable
George A. Kerr, Q.C.,
Minister.

Everett Biggs,
Deputy Minister.

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A. R. Chisholm, P.Ag.,
Executive Secretary to the Committee.

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INTRODUCTION

On January 27th, 1975, the Pesticides Advisory Committee received a request from the Pesticides Control Section, Ministry of the Environment (Appendix 1) to investigate Span-Spray equipment (Appendix 3) in order that its mode of operation relative to the licensing requirements as described under the Pesticides Act 1973 and Regulation 618/74, Section 59, may be determined and defined.

A Sub-Committee was formed for this purpose and the investigation included:

a) a field demonstration (Appendix 6)

b) solicitation of independent expert opinions (Appendices 4,5,7 & 8.)

RECOMMENDATIONS

1. It is recommended that for the purposes of the Pesticides Act 1973, a "Span Spray" machine be defined as an air-blast machine.

2. It is recommended that for the purposes of the Pesticide Act 1973, an air-blast machine be defined as one which utilizes an independent mechanically produced stream of air to assist the carrying of the pesticide beyond the orifice.

3. It is recommended that the application by an air-blast machine of hormone type herbicides, as interpreted in Ontario Regulation 618/74, Section 1 (j) be rigidly controlled through the prescribing of a Class 10 Land Exterminator's Licence.

CONCLUSIONS

The lack of research data documenting the relative effectiveness of various types of spraying equipment was very evident. The sub-committee recognized the great number of variables which can affect such research results and consequently the disinterest by researchers to undertake such testing. The sub-committee's conclusions are, therefore, based primarily on independent expert opinions and personal observation.

It was concluded, that the "Span Spray" machine is an air-blast machine for the purposes of the Pesticides Act.

The sub-committee also concluded that since the particle size emitted by the spray equipment is relatively small and the particles are transported by a stream of air, the use of hormone type herbicides could pose a severe threat to nearby susceptible crops through the danger of drift. In consequence, the sub-committee is of the opinion that before any licence is issued for the application of hormone type herbicides by means of an air-blast machine, a complete investigation of the situation be carried out by the Pesticides Control Section.

REPORT

On January 27, 1975, Mr. D. W. Wilson, Supervisor, Pesticides Control Section, Ministry of the Environment, wrote to Mr. K. G. Laver, Chairman of the Pesticides Advisory Committee, concerning sprayers (appendix 1).

The Pesticides Advisory Committee subsequently established a sub-committee to investigate spray equipment in general and "Span Spray" in particular. The sub-committee contacted the "Span Spray" manufacturer,Ring-Around Products, Montgomery, Ala. (appendix 2). The Company responded by providing the sub-committee with literature used in its current promotional program (appendix 3). No significant experimental data was supplied although the company promised to provide such data when it becomes available.

In the absence of such data, the sub-committee solicited the opinion of Dr. R. W. Fisher, Agriculture Canada, Vineland, Ontario (appendix 4). Dr. Fisher expressed the opinion that the "Span Spray" sprayer has very severe limitations as an effective machine and presents a distinct drift hazard (appendix 5). The opinion was collaborated by Dr. D. R. Menzies, an agricultural engineer with Agriculture Canada, Vineland, Ontario. Later Dr. Fisher further corresponded with the Committee and enclosed a letter from Hi-Acres Services Inc., Orlando, Florida (appendix 7). This Company had used "Span Spray" equipment on an extensive acreage for several years. Due to the ineffective control, the machines are no longer being used by this Company. Dr. Brooks, Extension Service, U.S.D.A., Lake Elford, Florida, confirmed dissatisfaction by the Florida growers (a telephone conversation with the sub-committee chairman).

A demonstration of the "Span Spray" sprayer was arranged for Wednesday, September 3rd, 1975 (appendix 6). The demonstration was held on the farm of Mr. Fred Payne, Caramet Farms Limited, R. R. 2, Strathroy, Ontario. Mr. Payne is a farmer and a custom spray operator, spraying extensive acreage.

Mr. Payne offered the following comments:-

(1) The "Span Spray" sprayer has been used by him for three years with no complaint nor damage claim.
(2) The "Span Spray" sprayer is limited to use by the expert operator.
(3) The "Span Spray" sprayer will be used by Caramet Farms Ltd. in 1976 for the application of hormone-type herbicides.
(4) The capability of the "Span Spray" sprayer to treat large acreage in a short time permits the operator to select ideal weather conditions for spraying.

(5) Compensation has to be made by the operator of the "Span Spray" machine for wind distortion of the spray swath.

(6) Standard boom sprayers were used to treat an 80' swath around all headlands.

In attendance at the demonstration was Mr. A. Hikichi, OMAF, Simcoe. Mr. Hikichi prepared an assessment of the "Span Spray" sprayer as a result of the demonstration and did some residue testing on the target product for the material used in the demonstration (appendix 8). It is his opinion that the "Span Spray" sprayer has very limited application and does present a distinct drift hazard.

On September 17th, 1975, the sub-committee viewed slides taken at the demonstration. It is recognized that particles in the lower micron size range are not readily visible to the naked eye. Therefore most of the particles reputed to be emitted by the "Span Spray" sprayer should not be visible. However, considerable

build-up material was visible under the machine indicating a "slobber" of much larger size particles being emitted from the orifice. The sub-committee agreed that the only method of transporting the particles from the orifices to the target was by means of an air stream.

Ontario

Ministry of the Environment

135 St. Clair Avenue West
Suite 100
Toronto Ontario
M4V 1P5

RECEIVED
FEB 3 - 1975
PESTICIDES ADVISORY COMMITTEE

PESTICIDES CONTROL SECTION

LOCATED: 1 St. Clair Ave. West
TELEPHONE: (416) 965-2401

DATE: January 27, 1975

MEMORANDUM:

TO: K.G. Laver
Chairman, Pesticides Advisory Committee

FROM: D.W. Wilson
Supervisor

RE: SPRAYERS

Under the Pesticides Act, 1973, a class 9 land exterminators licence is required by a person in order to apply Schedules 2,3,4 and 5 commercially from a concentrated airblast machine or power duster.

When this licence was drawn up initially the airblast machine in mind was the classical orchard machine. Since then, other modified and new equipments have appeared on the market, that vary in their use of air, for example ULV, foggers or aerosols, hydraulic sprayers.

We have a number of concerns regarding this equipment. Firstly, we have a problem in deciding which machines on the market are airblast and which are not.

Some of the equipment on the market is very useful and does a good job by directing the spray onto the crops, others seem to be hazardous. An example is the Span-Spray machine distributed in Ontario. The Distributor claims that it is not an airblast machine, however, the problem is the angle of emission of the particles, they are blowing straight up in the air. We discussed this machine with Dr. D.R. Menzies of CDA Vineland and he considers it hazardous.

Also, attached is information on a Bean Row Crop Sprayer blowing across a strawberry field and a Sprayall Sprayer blowing particles up into the air, both are undesirable.

Our concern is that we are issuing a licence for persons to apply pesticides with some very undesirable equipment and thereby encouraging the misuse of pesticides.

Another area of concern about sprayers is the particle size emitted. Some particle sizes emitted are below 100 MICRONS in diameter, these may result in deposition problems and all the other problems related to the material drifting off the target.

I have enclosed a list of sprayer distributors in Ontario and the distributors data on Span-Spray, Sprayall, Bean Sprayer with some comments by Dr. Bob Fisher, CDA Vineland on the sheets, Also enclosed for your information is an article from Science Nov. 1974 on the influence of particle size on urban aerosol toxicity with a covering letter put out by TIFA that incidently bears little correlation with the Science Article. I would appreciate any guidance that your committee can give me on the above areas of concern.

DW/rl
Encl.

Ontario

Sprayer Types - 1

(1) LARGE AIR-CARRIER WITH STANDARD NOZZLES

30-400 gal./acre
10,000 - 60,000 cu. ft. of air per minute

BEAN
HARDIE (LOCKWOOD)
SWANSON
MYERS
RSM
RITTENHOUSE
TECNOMA
BERTHOUD
VICTAIR

(2) SMALL - LARGE AIR - CARRIER WITH "AIR-SHEAR" NOZZLES

15-30 gal./acre
8-30,000 cu. ft. air/min.

KINKELDER
CONOMIST
KIEKENS
CONJET (RITTENHOUSE)
ECONOMIST
SPRAYALL

(3) VERY SMALL AIR AND LOW TO ULTRA-LOW LIQUID

SPANSPRAY
RITTENHOUSE TOWER CONJET
TURBAIR
MICRONAIRE

(4) CANNON TREE SPRAYER   LARGE Air vol. low liquid

TECNOMA
BUFFALO

(5) HYDRAULIC (NO AIR) ORCHARD, ROW-CROP, FIELD, GRAPE, GUN JETS, OR NOZZLE BOOMS, HOODED OR OPEN

RITTENHOUSE
CALSA (MYERS)
BEAN
HARDIE
TECNOMA
BERTHOUD
GOLDEN ARROW
FRIEND

(6) AIRCRAFT

MICROFOIL
MICRONAIRE } NOZZLE SYSTEMS
STANDARD

(7) AEROSOLS OR FOG MACHINES

SWINGFOG
BESLER etc.

(8) GARDEN SPRAYERS
OR HOUSE

TANK PRESSURE
GARDEN HOSE ATTACHMENT
AEROSOL BOMBS (FREON)
FLIT GUN
VACUUM CLEANER ATTACHMENT (AIR)

May 7, 1975

Dr. Keith Patricks,
Span Spray Division,
Ring Around Products,
Box 589,
MONTGOMERY, Alabama, 36101.

Dear Sir:

As you may already be aware, the use of pesticides in Ontario is contmolled under the Pesticides Act, 1973. Under this Act, the Ministry of the Environment has the responsibility to ensure the safe and effective use of pesticides in Ontario. One manner in which this is achieved is through the licencing of all custom spray operators.

The Ministry of the Environment is concerned about the use of span-spray equipment under certain conditions. To this end, this Committee is assessing the problem and will be recommending some course of action. In order to help the Committee make a sound judgment, we are requesting from you the technical data on the span-spray, for example, air speed, droplet size, etc.

We recognize the different concept of the span-spray equipment and congratulate your Company on its innovative approach to helping cut food production costs. However, we must also be concerned with the environmental impact.

I trust you will forward to us any pertinent information at your earliest possible convenience.

Yours sincerely,

PML:sp

Peter M. Lindley,
Member of Ontario Pesticides
Advisory Committee

RING AROUND PRODUCTS, INC.
P.O. BOX 589 • MONTGOMERY, ALA. 36101 • TELEPHONE (205) 365-5971

June 23, 1975

Mr. Peter M. Lindley
Pesticides Advisory Committee
Ministry of the Environment
Mowat Block, 5th Floor
Queens Park
Toronto, Ontario

Dear Mr. Lindley,

Please excuse the unwarranted delay in responding to your letter requesting information on the Span Spray concept of pesticide application, but both Dr. Patrick and myself have been involved in an extensive travel schedule in and out of the country. Our associates felt it best to wait our return to reply.

We are enclosing literature and technical data concerning Span Spray which hopefully answers the questions involved in your evaluation.

It should be pointed out a number of Span Spray studies are currently being conducted at Auburn University, Auburn, Alabama, North Carolina State University, Raleigh, North Carolina, The University of Arkansas, Fayettville, Arkansas and The University of Tennessee at the West Tennessee Experiment Station, Jackson, Tennessee, having to do with herbicide efficacity, drift, distribution, and coverage tests at various volume rates. Cornell University is evaluating our grape spray models also.

Results will be made available to you upon completion.

Basically our row crop systems can best be described as aerial spraying with ground equipment. Due to the constant application level above the crop, approximately 5 ft., we can operate at low total solution rates with less drift depositing chemical on the target plants and without the disadvantage of runoff attributable to conventional equipment.

As you will note in the enclosed data we use hydraulics exclusively. Pesticide solution is pumped at low pressure to revolving fan and cage assemblies which are turning from 3500 to 4000 rpm which through centrifugal force "shear" the material to 75-100 micron size particles. The fan is merely a method for moving the solution away from structural components of the sprayer. The system is by no means an air or blower type applicator. Span Spray in a sense was patterned after the Micronair system of aerial application.

June 23, 1975
Page Two
Mr. Peter M. Lindley

We would emphatically point out, we advocate less pesticide use with Span Spray not only as an economical tool for the grower, but one which we feel is advantageous environmentally.

In addition to the Span Spray information we have included a number of abstracts and papers on low and ultra low volume which led Dr. Patrick to develope the concept. They may be of some help in your total evaluation.

Hopefully we have furnished you with the information requested. Please do not hesitate to contact us if you require additional data or assistance.

Very truly yours,

AMBazzy

A.M. Bazzy
Manager, Span Spray Division
Ring Around Products, Inc.

AMB/mm

HOW DOES SPAN SPRAY FIT INTO THE LOW VOLUME PICTURE?

Actually, Span Spray is capable of applying pesticides at Ultra-Low Volume, Low Volume and Conventional rates.

From the standpoint of ground application, Span Spray makes it possible for growers to use Low Volume application rates on all crops. The system is capable of application rates of from 8 ounces per acre up to almost any rate desired.

HOW CAN SPAN SPRAY'S LOW VOLUME CAPABILITY BENEFIT A GROWER?

Time is the most important economic factor associated with Low Volume application. For example, time is extremely important to a cotton grower when he starts his spray program. If he is using a conventional spray rig, he can cover 80 to 100 acres a day at best because of the time he must spend filling, cleaning nozzles and screens. With the Span Spray system and applying chemicals at the more effective Low Volume rates, he can cover 300 to 400 acres per day. This greater daily coverage capability enables him to stay on an effective spray schedule.

Span Spray also enables the grower to make critical applications – applications that may save his crop. On peanuts, for example, a grower must get an application of fungicides back on his crop after a prior application has been washed off by rains. The enormous weight of three to five hundred gallons of water and chemicals used by conventional systems make it impossible to get that equipment into a wet field after a rain. But with the Span Spray system he *can* make this application when it needs to be made because the equipment is not badly weighted down.

DOES SPAN SPRAY'S LOW VOLUME APPLICATION PRODUCE EFFECTIVE COVERAGE ON TOUGH CROPS SUCH AS CABBAGE?

Yes. There are several vegetable crops that present a coverage problem for conventional systems. But Span Spray has achieved excellent coverage on cabbage, lettuce and, one of the most difficult, watermelons. Span Spray has even conquered the problem of controlling both early and late blight in potatoes and tomatoes in the Midwest.

Another example of Span Spray's superior coverage capability is the control of dotter in Yuchi clover. With dotter germinating under a heavy 2-foot cover of this clover, Span Spray has produced effective control. This is the first time dotter has ever been controlled commercially on a large scale.

IS THERE A DANGER OF APPLYING TOO MUCH CHEMICAL MATERIAL WITH SPAN SPRAY'S LOW VOLUME RATES?

Yes, especially some herbicides. With a soil-applied herbicide that breaks down, such as Cotoran, it is advisable to apply at the recommended rate. Incorporated herbicides should be applied at recommended rates because their effectiveness is based on parts-per-million of soil.

With contact or translocated herbicides you should cut the recommended rate a minimum of 25%. Actually, there have been instances in which half rates have been used successfully with some herbicides. The same rule-of-thumb – cutting the recommended rates a minimum of 25% – can be applied to insecticides and fungicides.

WILL THE SPAN SPRAY SYSTEM APPLY WETTABLE POWDERS?

Yes. Before the Span Spray system was developed, we were unable to consider Low Volume application of wettable powders. Since the Span Spray system has no nozzles to clog, wettable powders may be applied using the minimum amount of carrier for adequate coverage.

WHY, THEN, SHOULD A GROWER CONSIDER SWITCHING FROM A CONVENTIONAL SYSTEM TO THE SPAN SPRAY LOW VOLUME APPLICATION SYSTEM?

The primary purpose of any spray program is to get the material on the crop. Low Volume application rates have been shown to produce a superior deposit of spray material on all types of crops. This, therefore, is the most important reason for any grower to switch to Low Volume.

Low Volume makes it possible for a grower to cover more acreage per day and to maintain an effective spray schedule.

Low Volume makes it possible to make timely applications – applications at critical times such as after a rain – to get the material on the crop when it's absolutely necessary.

The speed of Low Volume application means a savings in labor, equipment and management time.

And Span Spray is the only Low Volume ground application system for row crops . . . the only Ultra-Low Volume application system for orchards.

Keith Patrick, Ph.D.
Director of Research and Development
Ring Around Products, Inc.

Low Volume and your spray program

WHAT IS LOW VOLUME?

To understand the term Low Volume you must first understand that Low Volume application rates can be different for different crops. For example, an application rate of *three quarts* of total solution per acre on cotton, soybeans and similar type rowcrops is considered Low Volume. *Fifty gallons* per acre in orchards is considered Low Volume. On vegetable crops, rates below *200 gallons* per acre are Low Volume.

Therefore, LOW VOLUME IS THE TERM USED WHEN APPLYING INSECTICIDE, FUNGICIDE OR HERBICIDE CHEMICAL MATERIAL TO CROPS USING THE MINIMUM AMOUNT OF CARRIER (USUALLY WATER) NECESSARY TO ACHIEVE EFFECTIVE CONTROL.

ULTRA-LOW VOLUME IS THE TERM GENERALLY USED WHEN APPLYING LESS THAN ONE-HALF GALLON OF TOTAL SOLUTION PER ACRE.

ARE GROWERS FAMILIAR WITH LOW VOLUME?

Yes. Every grower who has had pesticides applied to his crops with an airplane is familiar with Low Volume. But because he usually contracts with an aerial applicator for spray service, the grower has not concerned himself with the Low Volume principle or the reasons Low Volume is effective.

IS LOW VOLUME MORE EFFECTIVE?

Yes. Low Volume research has been conducted on almost every crop grown. Abstracts of close to 500 papers on the subject have been made available. The basic conclusion of this research is that Low Volume application rates will produce *better control* of pests than conventional rates.

In addition to the conclusions drawn from research, there are the results of grower spray programs that very definitely indicate a *superior effectiveness* of Low Volume when compared to conventional rate application.

WHY IS LOW VOLUME MORE EFFECTIVE?

The basic reason is Low Volume's ability to provide a *better deposit of the material on the target area.* The most effective droplet size in the spray application of chemicals to crops is within the 100 micron range. The Low Volume system's ability to break the chemical down within this 100 micron size is largely responsible for the better deposit of material on the plant.

Conventional systems are unable to produce more than a very small percentage of droplets in the 100 micron range. They must depend on large volumes of water as a carrier for the chemicals to get adequate coverage. As more water is used, more run-off occurs. And run-off reduces effectiveness.

WHAT ARE SOME ADVANTAGES OF LOW VOLUME APPLICATION?

When you look at any spray program, there are only two real results desired. One is to achieve the *pest control* you need. The other is to achieve this control at a *minimum cost.* Low Volume application produces both these results.

As previously explained, pesticides are more effective when applied at Low Volume rates because they *get* on the crop and *stay* on the crop.

The economics of Low Volume application are also much better than conventional. The most important economic factor in a spray program is time. The speed at which Low Volume systems apply pesticides makes it possible for a grower to cover his crop much faster than with conventional methods.

WHAT HAS BEEN THE PROBLEM OF LOW VOLUME APPLICATION?

Until recently the problem had been the availability of equipment – other than the airplane – capable of applying pesticides at Low Volume rates. There had been three major attempts to produce a workable Low Volume row crop application unit. All three failed to function properly and are no longer on the market.

IS THERE A LOW VOLUME GROUND SYSTEM AVAILABLE NOW?

Only one piece of ground equipment on the market today is capable of Low Volume application for row crops. That piece of equipment is the Span Spray system. A number of large air blast systems are still being represented as Low Volume. However, they are in the ten to fifteen gallon per acre range and fail to meet the Low Volume criteria.

Several foreign-produced pieces of equipment meet the Low Volume criteria for orchards. But Span Spray is the only piece of orchard equipment that will spray at Low Volume and Ultra-Low Volume rates.

IS SPAN SPRAY MORE EFFECTIVE THAN THE AIRPLANE?

Yes. Span Spray can apply a better swath than an airplane. It can cover some critical areas of crops near trees and other obstacles that are missed by aerial application.

May 7, 1975

Dr. R. W. Fisher,
Agriculture Canada,
Vineland Research Station,
VINELAND, Ontario,
LOR 2EO.

Dear Dr. Fisher:

Re: Span-Spray

In talking to Earle Muir, a member of the Ontario Pesticides Advisory Committee, he informed me that he had discussed the span-spray equipment with you. The purpose of his discussion was to receive your opinion on the above equipment for his work in the Committee.

We now have constituted a sub-committee of O.P.A.C. to review the span-spray as a safe and effective method of applying pesticides in Ontario. Several requests have been received for custom operators to use this equipment for the application of herbicides. Our Committee will be reviewing all the information we can gather, as well as observing a demonstration of the machine in action.

We would like you to express your opinion on the span-spray from two aspects; first, its relationship to other concentrated air-blast equipment and whether the span-spray could be classed as a C.A.B. machine; secondly, your opinion on the advisability of using this machine to apply herbicides.

We would welcome your attendance when we observe the field test of the machine. We would expect this to be in the near future and will advise.

Anticipating your response, I remain,

Yours sincerely,

PML:sj

Peter M. Lindley.
Member of Ontario Pesticides
Advisory Committee

Appendix 5

Agriculture
Canada

Box 185 Vineland Station, Ontario
LOR 2E0.

June 27, 1975.

Your file Votre référence

Our file Notre référence

Mr. A. R. Chisholm,
Pesticides Advisory Committee,
Mowat Block, 5th floor,
Queens Park,
TORONTO, Ont. M7A 1A2.

RECEIVED
JUL 3 - 1975
PESTICIDES ADVISORY
COMMITTEE

Dear Mr. Chisholm: re: Span Spray Equipment

I was sure I had written a letter to Earle Muir in addition to talking with him by telephone, but am unable to find a copy of it.

We have had no experience with this equipment but have seen the description and affidavits "proving" its outstanding performance.

We have discussed the sprayer and have the following opinions and communications:

1. It is not an air-blast sprayer
2. It is a ~~low-~~ medium to ultra-low volume applicator
3. It could not operate effectively in windy weather and its power would be too low to project spray effectively into dense crops like strawberries, beans, carrots, sweet cherries, etc.
4. Evaporation of droplets would preclude use of water as a dispersant
5. Droplet size would be small and drift would be extensive
6. We would not consider it to apply any herbicide in cropland because of drift
7. Personal communication with researchers in the U.S. revealed their displeasure with the machine from the drift aspect
8. Experimental data have shown its performance to be inferior to most other sprayers on the market. (see enclosure)

Yours truly,

Robert W Fisher
R. W. Fisher
Entomologist

D. R. Menzies
D. R. Menzies
Agricultural Engineer

RWF/MB

C: Span Spray. See 399 400

Low Volume Applications to Citrus Trees: Method for Evaluation of Spray Droplet Distributions[1,2]

G. E. Carman and L. R. Jeppson

Department of Entomology, University of California, Riverside 92502

ABSTRACT

The method permits evaluation of spray droplet depositions in various areas of citrus trees following LV applications with either aerial or ground sprayer units. Untreated cards rigidly positioned at selected tree stations in each of a group of test trees are collected following applications of water containing a fluorescent dye. Sample areas provided by the uniform superimposition of a perforated template on each card surface are examined under UV light and 10 × magnification to determine presence or absence of deposited spray droplets. The same target trees are used for comparative runs in an appropriate series. The method is designed to indicate tree areas which receive no or only limited droplet depositions rather than to characterize or emphasize the quantitative aspects of the coverage accomplishment.

Recent improvements in LV sprayer units for use on deciduous tree crops and their increasing usage in pest control practice on these crops has renewed the interest in this method of application for pest control on citrus crops.

The newer units produce large numbers of suitably small droplets that easily can be entrained in a directed air stream to achieve distributions to all tree surfaces. The adequacy of such applications depends on the degree to which these small droplets can be distributed to and deposited on all the tree surfaces frequented by the individual pest and the effectiveness of such deposits in controlling the pest.

Prior to undertaking bioassay studies it was considered advisable to determine the application units and the operating conditions which provided the most effective droplet depositions. This report describes the method of evaluation developed and the results of some of the studies completed.

Background for Method.—With the assumption that LV spraying would generally involve the use of only 100 gal/acre or less of spray, it was clearly evident that maximum deposition would not provide continuous film wetting of all tree surfaces. Thus, a closely textured stipple pattern of deposited droplets would represent the ideal achievement. The required number of droplets per unit area would undoubtedly depend on the type of pest to be controlled and the chemical and physical attributes of the pesticide being used—considerations which could only be evaluated in bioassay trials.

It also was apparent that most equipment for effecting LV spray applications would achieve variable deposition patterns in different parts of the tree. This would be most evident with ground equipment which might film wet tree surfaces close to the unit as it passed the tree. Other surfaces in the tree conceivably could receive little or no spray deposits with a resulting loss of treatment efficacy. The method of evaluation developed for these studies was structured to measure the deficiencies of droplet depositions in various parts of the tree.

Other workers who have studied the depositing capabilities of LV sprayers on tree crops have utilized methods which primarily characterized the magnitude of the deposits in different parts of the tree target. These methods have depended largely on the collection of samples from different tree areas and the chemical determination of the deposits or included dyes or the visual rating of conversion products or fluorescing dyes (e.g. Blodgett and Meador 1934, Howard and Schlenker 1947, Blinn and Lovell 1965, and Bullock et al. 1968). All such methods, inclusive of a wide range of techniques, provide good evidence of the relative level of spray depositions in various parts of the tree, but are less useful in identifying specifically oriented surfaces in different tree areas which have received little or no deposits of spray. Additionally, endeavors to compare different applicators or different operational procedures by the use of such methods involve the use of different sets of tree targets, a variable which can mask significant differences. The measurement of droplet sizes has been studied extensively, both with regard to deposition factors and to treatment efficacy. In such studies standardized artificial surfaces have been used often, permitting the use of the same target areas. The method devised for the studies being reported also capitalizes on the use of artificial surfaces and the same tree targets, and additionally emphasizes the deficiencies of droplet distributions in a comprehensive selection of tree locations.

Methods and Materials.—The present method developed for the measurement of spray droplet distributions in citrus trees involved the use of paper cards positioned in predetermined locations in each of a selected group of test trees prior to the application of a fluorescent dye spray and the subsequent determination in the laboratory of droplet depositions on systematically sampled areas of the card surfaces. The cards were pre-cut from 5×8 in., 8-point index card stock and measured $2\frac{1}{4}\times2\frac{5}{8}$ in. Cherry red was found to be a preferred card color both to facilitate detection in the trees and for definitive determinations of droplet depositions on the card surfaces.

Tree stations were selected to provide samplings at different heights within the tree structure and at different distances from the spray emissions. The latter were determined with regard to both the distance away from the tree center or trunk and a radial placement in reference to a zero degree base line common with the tree row.

A card holder was rigidly clamped to a tree branch at each indicated station position. The holder consisted of a 4-in. long piece of ½-in. maple dowelling stock with a 2-¼ in. Hunt spring paper clip attached on each end with small bolts. The clips were affixed to the dowelling

[1] Received for publication May 8, 1973.

[2] The authors are indebted to J. O. Complin, H. S. Elmer, M. J. Jesser, J. L. Pappas, O. L. Wolfe, and G. F. Wood for technical assistance and help in these studies.

Table 1.—Ground sprayer unit number identifications and operating conditions for the reported tests.

Unit	Name	Nozzle type and arrangement	lb/in.²	Gal/acre	MPH	Reference rpm (engine or fan)	Oscillation
I	Dickton[a]	*7/64" SS (convex disc)*	26	51	1.35	—	55 opm
II	Kinkelder Royal[b]	*10-open ended—both outlets to one side* valve setting = 86	24	50	1.41	2100	—
III	Turbo-Mist 38 CD[c]	*SS-convex disc-No. 24 whirlplate* B 2, 3, 3, 3, 3, 3, 2 T	116	66	1.48	2800	—
IV	SpeedSprayer E 757 CPCD[d]	*Bean disc type (holes in whirlplate)* 7-2½ (1)	200	65	1.50	2350	Without
V	Bean E-200-TR[d]	*Bean disc type (holes in whirlplate)* 7-2½ (1)	200	62	1.40	2600	—
VI	RSM-4 spout[e]	B 0.75, 0.75, 1.25, 1.0 T	300	54	1.41	—	—
VII	Span Spray[f] (4 fans)	*SS-4916 Internal disc type* B 40, 52, 52, 52 T	50	52	1.49	950	—
VIII	Windmill 500[g]	*10-open ended—both outlets to one side* valve setting = 90	22	48	1.55	2100	—
IX	Air-O-Fan[h]	*SS-ODTC-No. 25 core (x = blank)* B 2, X, 3, X, 3, X, 3, X, 3 T	120	50	1.49	2400	Without

[a] Dickton Fans, Morgan Hill, Calif.
[b] Marwald Orchard Equipment Ltd., Burlington, Ontario, Canada.
[c] Okanagan Turbo Sprayers Ltd., Penticton, B.C., Canada.
[d] John Bean Division, FMC Corp., San Jose, Calif.
[e] Fruit Machinery Company, Mercersburg, Pa.
[f] Span Spray Division, Ring Around Products, Inc., Montgomery, Ala.
[g] Gervan Distributing Company, Modesto, Calif.
[h] Kraus & Noonan, Modesto, Calif.

length so that the inserted cards would be held on perpendicularly oriented planes in relation to one another. The holder was held by a ring stand clamp holder with the distal end clamped to a branch so as to position one of the cards on a plane parallel with the ground surface. Difficulties in positioning the card holders in a specific tree location because of the lack of a suitable branch were overcome by clamping a dowel extension of suitable length to a nearby branch and attaching the card holder to the simulated dowel branch.

The cards were precoded to identify the specific test, the test tree, the tree station, and the orientation of each card surface. The surface of the card bearing the code information was inserted into the clamp holders and was not sampled in the subsequent examinations for droplet distributions. During a succession of runs, new cards were not positioned in the clamps until the trees were dry from the previous application.

The spray mixture contained only a fluorescent dye. Any of several such dyes could prove useful but in these tests a product identified as fluorescein dye mix (Tech.)[3] was used at the rate of 200 g/100 gal water.

Following the actual spray application and after the trees were essentially dry, the cards were collected from each test tree and segregated in small kraft paper bags for transport to the laboratory. Each card surface was examined under a flood of UV light and with 10 × magnification provided by the use of a stereomicroscope. The areas to be examined on each card surface were determined by rigidly positioning the card in an open-ended wooden form attached to a 4×4 in. piece of ¼-in. plywood and superimposing a perforated template the size and shape of the exposed portion of the card surface. The template was fashioned from very thin brass shim stock and perforated with an 8×9 pattern of equidistantly spaced holes 0.007 in. diam. By pushing the card and template against the receiving end of the wooden form while completing the examination of the selected sample areas, shifting of sample surfaces was readily avoided. The critical determination for each of the 72 sample areas was whether or not any deposition of fluorescing dye was observable. The number of the examined areas on each card surface which had dye present was recorded on forms which provided entries for the tree stations and the orientation of each card surface for a single test tree. The results are expressed either as percent of examined areas with deposited spray droplets or as percent without deposited droplets. Segregations can be made to show the droplet distributions achieved in various parts of the tree or on the variously oriented card surfaces.

APPLICATION OF TEST METHOD.—Table 1 lists the types of ground sprayers and the operating conditions for the tests. Tables 2–4 present results of tests involving comparisons of the ground sprayers. Table 5 presents results of tests with aerial application units.

The tests on ground sprayers were undertaken at the Citrus Research Center, Riverside, on 4 fully mature "Valencia" orange trees. The trees were spaced 20 ft apart in the row and were sufficiently developed that only ca. 3 ft separated the trees in the row. Average tree height was 19 ft, and the peripheral shell structuring of each tree was reasonably dense and free of voids. A crop of mature size fruit was present on the trees. Tests were performed under conditions of no or minimal air movement and were discontinued with any change.

The sprayer units were operated at optimal performance levels at selected gallonage per acre rates and at forward ground speeds predetermined to be nonlimiting to droplet distribution achievements (Table 1). Each row side of the test trees was sprayed as uniformly as possible. Each sprayer unit was calibrated by the weight loss method to provide guidance for the nozzle selection or valve setting for each run. Actual forward ground speeds were determined for each run. Modest variations in ground speeds and actual gallonage rates of

[3] Atlas Chemical and Manufacturing Company, San Diego, Calif.

Table 2.—Spray droplet distributions achieved by several sprayer units at various sampling stations in Valencia orange trees, Riverside, Calif., April 1970.

Station	Height above ground (in ft)	Angle[a]	Position[b]	Target gallonage = 50 gal/acre Avg % examined areas per card surface with spray droplet depositions[c]								
				Sprayer unit								
				I	II	III	IV	V	VI	VII	VIII	IX
1	1	0°	P	91.4 a[d]	89.8 a	99.8 a	95.4 a	96.7 a	98.2 a	42.7 c	89.9 a	64.0 b
2	1	45°	P	82.2 b	91.0 ab	98.2 a	97.8 a	97.1 a	98.4 a	32.3 d	94.2 a	69.4 c
3	1	90°	P	58.8 c	88.3 a	98.6 a	97.7 a	98.1 a	96.1 a	35.3 d	91.0 a	69.1 b
4	4	0°	P	94.7 ab	94.0 ab	99.5 a	87.2 b	97.7 ab	74.2 c	43.8 d	99.9 a	98.3 a
5	4	45°	P	97.2 ab	95.6 ab	99.7 a	87.8 b	98.7 ab	96.2 ab	48.7 c	96.9 ab	94.5 ab
6	4	90°	P	99.2 a	98.7 a	99.9 a	94.3 a	98.4 a	99.6 a	52.5 b	99.6 a	93.1 a
7	7	0°	P	98.7 a	94.7 ab	91.9 ab	91.1 ab	85.0 b	96.4 a	45.3 c	97.3 a	89.4 ab
8	7	45°	P	97.4 a	97.7 a	93.6 a	93.3 a	92.0 a	97.4 a	38.8 b	95.7 a	89.8 a
9	7	90°	P	95.6 a	98.0 a	97.9 a	97.1 a	95.2 a	99.6 a	49.8 c	99.4 a	84.4 b
10	7	0°	½	100.0 a	99.8 a	99.7 a	98.1 a	98.5 a	99.1 a	55.5 b	98.6 a	98.8 a
11	7	45°	½	98.5 a	97.9 a	98.0 a	96.5 a	93.2 a	97.5 a	44.7 b	98.4 a	95.4 a
12	7	90°	½	97.9 a	99.6 a	98.5 a	98.6 a	96.8 a	99.2 a	54.1 b	99.6 a	95.6 a
13	10	0°	¾	70.6 c	93.1 a	76.7 c	97.0 a	79.1 bc	91.9 a	56.3 d	89.8 a	87.9 ab
14	10	45°	¾	72.7 e	95.2 ab	83.2 cd	97.0 a	85.4 bcd	92.9 abc	77.1 de	89.6 abc	91.6 abc
15	10	90°	¾	88.0 ab	98.4 a	86.0 b	98.4 a	92.1 ab	97.5 a	75.4 c	96.2 ab	95.0 ab
16	10	—	C	94.2 a	98.3 a	80.4 b	99.4 a	91.1 a	98.5 a	71.0 b	98.4 a	99.1 a
17	13	0°	½	31.5 f	80.0 c	67.2 de	96.3 a	74.4 cd	90.8 ab	60.6 e	72.8 cd	83.5 bc
18	13	45°	½	48.9 d	93.6 ab	83.8 bc	95.7 a	86.4 abc	95.9 a	79.2 c	81.5 c	94.5 a
19	13	90°	½	51.9 c	89.2 ab	84.8 b	97.2 a	85.2 b	88.7 ab	79.0 b	80.4 b	86.1 b
20	13	—	C	36.3 e	93.4 ab	76.0 d	94.1 a	82.4 cd	95.2 a	73.4 d	83.3 bcd	90.1 abc
21	16	—	C	23.2 d	78.5 a	60.3 b	82.5 a	59.6 b	76.2 a	59.6 b	48.4 c	80.6 a
22	16	—	C	23.0 d	65.6 b	61.1 b	80.6 a	60.6 b	71.2 ab	48.7 c	42.4 c	78.6 a
All	—	—	—	75.1 c	92.3 a	88.0 b	94.2 a	88.4 b	93.2 a	55.6 d	88.0 b	87.7 b

[a] Target position related to axis of rows and line of equipment travel.
[b] Target position within tree where P = peripheral area; ½ = an area equidistant from the trunk of the tree to the outside edge, ¾ = an area ¾ distance from the trunk to the outside edge; and C = the center area of the tree over tree trunk position.
[c] Total of 72 examined areas/card side.
[d] At any one station, machines with no letter or letters in common are significantly different at the 5% level of significance.

all very low

Appendix 5 (continued)

Table 3.—Spray droplet distributions achieved by several sprayer units in Valencia orange trees at station locations referenced to internal tree positions and the row alignment of the test trees, Riverside, Calif., April 1970.

	Target gallonage = 50 gal/acre Avg % examined areas with spray droplet depositions (numerical entries) Statistical categorization of numerical values for purpose of expressing significance (alphabetical entries)[a] Station locations without reference to vertical placement[b]										
	In peripheral shell			¾ distance from trunk			½ distance from trunk				
Sprayer unit	0°	45°	90°	0°	45°	90°	0°	45°	90°	Tree center	Avg droplet distribution (all surfaces)
I	94.9 ab	92.3 a	84.5 b	70.6 c	72.7 e	88.0 ab	65.8 c	73.7 b	74.9 b	44.2 e	75.1 c
II	92.8 ab	94.8 a	95.0 a	93.1 a	95.2 ab	98.4 a	89.9 ab	95.7 a	94.4 a	83.9 a	92.3 a
III	97.1 a	97.2 a	98.8 a	76.7 c	83.2 cd	86.0 b	83.5 b	90.9 a	91.7 a	69.5 bc	88.0 b
IV	91.2 ab	93.0 a	96.4 a	97.0 a	97.0 a	98.4 a	97.2 a	96.1 a	97.9 a	89.1 a	94.2 a
V	93.1 ab	95.9 a	97.2 a	79.1 bc	85.4 bcd	92.1 ab	86.5 b	89.8 a	91.0 a	73.4 b	88.4 b
VI	89.6 b	97.3 a	98.4 a	91.9 a	92.9 abc	97.5 a	95.0 a	96.7 a	94.0 a	85.3 a	93.2 a
VII low	43.9 d	39.9 c	45.9 c	56.3 d	77.1 de	75.3 c	58.0 d	61.9 c	66.5 c	63.2 e	55.6 d
VIII	95.7 ab	95.6 a	96.6 a	89.8 a	89.6 abc	96.2 ab	85.7 b	89.9 a	90.0 a	68.1 de	88.0 b
IX	83.9 c	84.5 b	82.2 b	87.9 ab	91.6 abc	95.1 ab	91.1 ab	95.0 a	90.8 a	87.1 a	87.7 b

[a] At any one station, machines with no letter or letters in common are significantly different at the 5% level of significance.
[b] Target position within tree where P = peripheral area; ½ = an area equidistant from the trunk of the tree to the outside edge; ¾ = an area ¾ distance from the trunk to the outside edge; and C = the center area of the tree over tree trunk position.

Table 4.—Spray droplet distributions achieved by several sprayer units in Valencia orange trees at tree locations various heights above ground level, Riverside, Calif., April 1970.

Sprayer unit	Target gallonage = 50 gal/acre. Avg % examined areas with spray droplet depositions (numerical entries). Statistical categorization of numerical values for purpose of expressing significance (alphabetical entries)[a]. Station location with reference to vertical placement in tree in ft: 1	4	7	10	13	16	Avg droplet distribution (all surfaces)	
I	77.5 d	97.0 a	98.0 a	81.4 c	42.1 e	23.1 f	75.1 c	
II	89.7 c	96.1 a	98.0 a	96.3 a	89.0 b	72.0 c	92.3 a	
III	98.9 a	99.7 a	96.6 ab	81.6 c	78.0 c	60.7 d	88.0 b	
IV	97.0 ab	89.8 b	95.8 abc	97.9 a	95.8 a	81.6 a	94.2 a	
V	97.3 ab	98.2 a	93.5 bc	86.9 b	82.1 c	60.1 d	88.4 b	
VI	97.5 ab	90.0 b	98.2 a	95.2 a	92.7 ab	73.7 bc	93.2 a	
VII	36.8 f	48.3 c	48.0 d	69.9 d	73.0 d	54.1 d	55.6 d	low
VIII	91.7 bc	98.8 a	98.2 a	93.5 a	79.5 c	45.4 e	88.0 b	
IX	67.5 e	95.3 ab	92.2 c	93.4 a	88.6 b	79.6 ab	87.7 b	

[a] At any one station, machines with no letter or letters in common are significantly different at the 5% level of significance.

application were countenanced, but substantive deviations from the desired operational conditions necessitated a rerun. In these tests, a worker was assigned a particular tree for the entire series of tests and, in addition to placing and recovering the cards, also completed the laboratory evaluations for his assigned tree.

The results from the use of aerial sprayer units (Table 5) were obtained from trials conducted on mature navel orange trees in the Corona and Riverside areas.

DISCUSSION.—Clearly, the use of a nontree surface to determine droplet depositions is subject to valid criticism. Such surfaces cannot simulate the size, shape, surface characteristics or other biological features of a tree. The deposition of droplets on the card surfaces merely provides evidence that the spray reached that particular tree area. The primary determination is droplet distribution and the presence of the smallest observable droplet in the sampled area is recorded the same as the presence of a much larger droplet. A useful modification of the method might be based upon a quantitative determination of the amount of dye present on each sampled area. The rationale for the method described is that it is most critical to identify the areas within the tree structure that are receiving little or no spray droplet depositions. If these are extensive, the sprayer unit being used is not suited to the task or is not being operated properly. If efforts are made to alter the physical make-up of the unit or to change operating conditions, subsequent evaluations are particularly useful and valid since the same tree targets can be used.

A principal disadvantage of the method was the manpower and time requirement. Considerable time was spent in preparing, coding, and segregating the cards prior to the runs in addition to that spent after the runs in inspecting the sample areas on each card. The examined areas totalled 6,336 for each test tree in a run. To expedite the runs, an individual worker was assigned

Table 5.—Spray droplet distributions achieved in navel orange trees by aerial sprayer units at various tree heights and on various surface orientations.

Sprayer unit	Amount/ acre (gal)	Air speed (mph)	Distance spray boom above trees (ft)	All surfaces	Horizontal surfaces: Upper	Lower	Station location with reference to vertical placement in tree in ft: 3	6	9	12
				Corona, Calif.—May 19, 1966						
Fixed-wing (Pawnee Piper)	15	85	5	5.7	14.3	0.0	2.5	4.0	7.1	20.2
	15	85	15	5.6	17.5	0.0	1.8	3.6	8.8	18.2
	15	85	25	2.8	8.0	0.0	1.1	2.2	3.3	10.5
				Corona, Calif.—Apr. 1, 1966						
Helicopter (Bell 47G-4)	15	50	5	7.3	11.8	0.3	4.1	4.2	9.8	24.4
	30	25	5	13.8	22.5	2.3	11.4	12.4	14.6	27.0
	73	10	5	24.4	35.8	3.9	20.1	19.5	31.1	41.7
				Riverside, Calif.—Feb. 25, 1967						
Helicopter (Hughes 300)	30	60	5	15.9	33.1	1.4	12.6	17.2	17.0	21.0
	45	40	5	17.0	27.2	4.6	14.1	11.3	23.3	32.2
	90	20	5	48.0	69.2	15.7	43.6	39.4	58.4	68.2

to each test tree for card placement and retrieval and two others were involved in preparing for and completing the actual spray applications.

A selection of only the most critical tree areas with regard to spray coverage would greatly reduce the work requirements and in many cases would provide the information needed for evaluative purposes. Variations also could be made in the sampling procedure. The number of test trees could be increased profitably if great variations in tree conformation were encountered or more critical evaluations were required. Fundamental to the entire procedure is the use of the same tree targets and the rigid positioning of the card holders for a comparative series.

Citrus trees are difficult spray targets because of the frequently dense peripheral shell structuring. The bulk of the foliage, twigs, and fruit is in this area although under the most favorable growing conditions there will be a considerable development of such growth in the interior of the tree. Younger trees frequently exhibit this more bushy type of development. The basic growth pattern of citrus trees poses a particular difficulty for low silhouette machines since the emanating spray pattern cannot be carried into the top center of the tree without penetrating upwardly through the vertical extension of the peripheral shell. This, coupled with the need to penetrate the horizontal depth of the peripheral shell in the tree row area and to drive to the back surfaces of fruit, leaves, and twigs on the far side of the tree, emphasizes the severity of the coverage challenge and the desirability of evaluating spray coverage accomplishments in a comprehensive manner. On tree crops with less dense or less complete structuring, some intensification of the sampling procedure and deposition assessments might be required to permit critical evaluations.

In the tests reported, applications by aerial sprayer units achieved only limited droplet deposition patterns in most tree areas and virtually none on certain surface orientations (Table 5). At comparable gallonage rates, results with fixed-wing and helicopter equipment were very similar. Helicopters operated at lower and largely impractical air speeds to provide greater gallonage rates, achieved better droplet depositions, but with notably different distributions on upper and lower surfaces and in the upper and lower parts of the tree. At a nearly comparable gallonage rate, results with aircraft applications appeared greatly inferior to those achieved with ground sprayer units although it must be noted direct comparisons were not made. Supportive to the observation is the fact that the target trees used in all the ground sprayer tests were larger and more fully developed than those used in the aircraft trials.

Results with ground sprayer units indicate that Units II, IV, and VI were, on an overall basis, significantly better than any other units when used at the target gallonage rate of 50 gal/acre. Unit IV may have been advantaged in the tests by the slightly higher gallonage actually applied, but is of special interest since this equipment was originally engineered for dilute spray usage and is herein demonstrated to be adaptable to LV applications. Units III and IX also were designed originally for higher gallonage rates.

While the manner of droplet formation in Unit II involves the shearing action of high velocity air and in Unit VI the use of relatively high hydraulic pressures in combination with the counter-movement of air at high velocity, the spray achievements appear to be comparable. Both procedures appear to produce droplet sizes in the range suitable not only with regard to the number from a unit volume of spray but also with regard to the ease of projecting them toward and into the tree. The provision on each unit for projecting the spray droplets in an effective pattern into tree areas also was different. The 4 emission spouts in the fan housing of Unit VI appeared to provide less uniform distributions in the lower parts of the trees than did the fan-shaped outlet of Unit II but compensated by being slightly more effective in achieving distributions in the higher tree levels.

Both of these units failed to achieve uniformly good droplet depositions in the tops of the trees (Table 4). This difficulty is apparent in the results with other of the ground sprayer units tested. It demonstrates that low silhouette machines are limited in their capabilities to effect comparable coverage in the upper tree areas because of the basic shape, structure, and density of the citrus tree. Unit VII had individual fans positioned on a vertical mast in a manner which had the potential to overcome this coverage deficiency, but performed inadequately because of unsuitable droplet sizes and insufficient air drive from the hydraulically-driven fans.

Units III, V, VIII, and IX demonstrated relatively good effectiveness in these trials. With slight modifications of the units or adjustments in operating conditions or with increases in gallonages upwards to 100 gal/acre, they would be expected to provide improved droplet deposition patterns.

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good position & potential but poor performance.

Ontario

K. G. Laver
Chairman

A. R. Chisholm
Executive
Secretary

Ministry of the Environment

Pesticides Advisory Committee

416/965-7048

Mowat Block
5th Floor
Queen's Park
Toronto Ontario
M7A 1A2

August 22, 1975

MEMORANDUM

To: Members of the Pesticides Advisory Committee

From: P. M. Lindley

Re: Span-Spray Equipment

A demonstration of the Span-Spray sprayer will take place on Wednesday, September 3, 1975, commencing at 8:00 a.m. on the farm of Mr. Fred Payne at Caramet Farm Ltd., R.R. # 2, Strathroy, Ontario. The farm is located on the east side of County Road 9, between Strathroy and Melbourne in Caradoc Township.

It would be appreciated if the members of the Spray Equipment Sub-committee, namely, Messrs. Ingratta, Muir, Stephenson, Taylor and Wilson, would attend, but all members of the Pesticides Advisory Committee who are interested in attending are invited. Dr. Fisher of Agriculture Canada, Vineland, has also been invited.

P M Lindley

PML:sp

P. M. Lindley
Chairman
Spray Equipment Sub-committee

Agriculture
Canada

Research Branch

Research Station,
Box 185,
Vineland Station, Ont.,
L0R 2E0.

28 August, 1975.

Mr. P.M. Lindley, Chairman,
Spray-equipment sub-committee,
Pesticides Advisory Committee,
Mowat Block, 5th Floor,
Queen's Park, Toronto, Ontario,
M7A 1A2.

Dear Mr. Lindley:

Thank you for your invitation to witness a demonstration of "Span-spray" Sept. 3, 1975. Unfortunately, I have a medical appointment on Sept. 3 and cannot change it. Dr. Menzies, our Agricultural Engineer, also will not be able to attend. If it had been scheduled a few weeks earlier, we might have been able to plan for it, but I expect that you had no early notice either.

I am interested in the timing of the test at 8 o'clock in the morning. Obviously they wish the test to work and be dramatic. At that time there will be no wind to deflect the meagre air flow, the high humidity will keep the droplets the original size, there will be no upward convections to lift and drift the spray, and the low sunlight angle will give you a fine view of the spray against a dark green background.

If they were to insist that the sprayer be used only under these conditions and only on row crops where the air is directed downward, then they might be looked on favourably. But, if the sprayer were operated later in the day when the air is turbulent,hot, and dry, then it might be unacceptable.

Enclosed is a copy of a letter from a dissatisfied customer in Florida. From his experience I expect the Span Sprayer would do no better in our dwarf apple, peach, or pear trees and certainly would be useless in large trees.

We have over 35 models of sprayers in Ontario now and the farmers have difficulty enough coping with all the other variables without having a new machine that would

likely operate well only under very restricted conditions. A farmer well informed is pretty cautious and will make the right decision. But so many hear only the seller's glowing claims.

Kitch and I have been checking sprayers with dye and know the problems a farmer faces. We wouldn't advise a farmer to buy any sprayer that we hadn't examined ourselves, which I think is a reasonable attitude to have since we are government employees and tax-paid.

If you can find a good deposit on the lower surface of potato leaves within 3" of the ground between rows in August, then the sprayer is covering effectively.

Kitch from Simcoe might be there in my place. I regret not being able to attend the demonstration with you. I have a meeting in London Sept. 4 in the evening. If the sprayer were still in the area on Sept. 4 I might be able to see it, even early in the morning.

Sincerely,

Robert W Fisher

Robert W. Fisher,
Research Scientist.

Hi-Acres Services, Inc.
Post Office Box 7853, Orlando, Florida 32804 Telephone (305) 838-3110

"No Substitute for Quality"

August 7, 1975

Dr. R. W. Fisher
Canada Agriculture Research Station
Vineland Station
Ontario Lorzeo, Canada

Dear Dr. Fisher:

In reply to your recent inquiry concerning the Span Sprayer I can relate my experience with citrus only.

The Span Sprayer was used for several years by Hi-Acres, attempting to control pests, scale, and fungus diseases over our 10,000 acres of groves. This proved to be a miserable failure. The machine does not have sufficient wind velocity to penetrate even a small citrus tree. We tried speeds from one to three mph in various combinations of 10 to 40 gallons of material per acre with very little success. At best, coverage is poor.

The machine also warrants a constant routine of repairs. Our fleet of Span Sprayers are currently for sale.

If I can be of any futher assistance please do not hesitate to call on me.

Sincerely,

Lester Austin /tw

Lester Austin
Grove Production Manager
Hi-Acres Services, Inc.

LA:tw

Assessment of Span Sprayer as an Agricultural Spray Application Equipment

Hikichi, A., Ontario Agriculture and Food,
Simcoe, Ontario.

Description of the Equipment: Four spinning cage atomizers, somewhat similar to Micronair, mounted on a 40 ft. boom which can be hydraulically manipulated to different heights. Unlike other air assisted sprayer where the spray is directed down on the crop, these atomizers were arranged to spray horizontally across the boom, with two atomizers to a side. Each atomizer was arranged to cover a swath of 20 feet, therefore total swath of eighty feet.

The rate of spray mixture was controlled by a central metering device to deliver from 1½ to 3 gallons per acre at travel speed of 5¼ to 9 m.p.h.

The atomization was based on the spinning cage principle where the metered spray mixture is released into a spinning metal screen cage revolving at 3800 R.P.M. The mass median diameter was claimed to about 50 microns with the range between 30-150 microns. MMD can be changed by switching to cages with different mesh screen.

The dispersal of the spray was accomplished by the four fins attached to the wire cage. The air displacement was supposed to be 200,000 cu. ft. but this is a nebulous figure which is hard to substantiate.

The spray coverage on field corn was assessed on the tip leaves, and 3 feet from the ground. These leaves were sampled on the 4th,8th, and 12th row with row spacing of 38". The leaves were sprayed with 150 gms. Phosphos 2283 in 25 gal. of water with the sprayer travelling at 5¼ mph. when wind speed was 2-4 mph. Though attempt was made to permit the leaf samples to dry, the foliage was moist at sampling.

Assessment

The readings under binocular microscope with ultra violet light were made on the upper and lower surface of five leaves per site at four areas of the top leaves and eight areas on the bottom leaves. Because of the moist conditions, it was felt that we were assessing the distribution of dye particles in water, and not the spray deposits. These particles were so small that they were found only with binoc.

Results

		12th Row		8th Row		4th Row	
		Upper	Lower	Upper	Lower	Upper	Lower
1st leaf down from tassel		2.30	2.20	2.40	3.60	3.90	2.65
leaf - 3 ft. from ground	End.	2.10	2.30	.70	1.15	2.40	1.70
	Base Sec.	1.00	.80	1.10	1.85	2.95	1.85

When assessment was made of spray deposits (aggregate of dye particles) on tree fruit the readings between 4 to 7 are considered to be good spray coverage. On row crops such as on crucifer, rating of 2 was sufficient for control of loopers. According to this assessment based on dye particle distribution instead of spray deposits, the spray coverage is considered to be on the low side.

The question arises, whether the particle size which we guess to be below 10 microns are sufficient for control. Work on this is currently underway in Vineland Research Station. The only supporting evidence, for these small particles comes from Himmel (1969) who state

that optimum size of particle should be between 10-20 microns. However Coutts and Furmidge (1972) who worked with 50-60 micron droplets state, "whether or not the small number of drops and the variability from leaf to leaf cause inefficient pest control depends upon the relative movements of the pest or pesticide, and on the degree of their interaction". In this writer's opinion, the spray from the machine may be effective if the application is timed when the pest is on the move e.g. newly emerged corn borer, adults in flight etc. This probably accounts for the current use on spruce budworm moths. For disease control, the coverage rating indicates that the control will be ineffective because of wide and varied distribution of particles.

Without considering the air contamination aspect from the small droplets, it is this observer's opinion that its use is limited to specific control and not general control for which many of the current sprayers are used.

Reference

Coutts, H. H., & G.G.L. Furmidge (1972). The future for aerial application of ultra-low volume sprays. International Pest Control.

Himmel, C. M. (1969). New Concept in insecticides for Silviculture. Int. Agr. Aviation Congress.